

C L A I M S

1. A multi-beam antenna transmitter/receiver
2 characterized by having a plurality of reception beams
3 and a plurality of transmission beams, and selecting the
4 transmission beam on the basis of overall reception
5 qualities calculated from reception qualities of path
6 delays of user signals present in the plurality of
7 reception beams.

2. A multi-beam antenna transmitter/receiver
2 according to claim 1, characterized in that the
3 reception beam is selected on the basis of the overall
4 reception quality, and the transmission beam having a
5 direction which coincides with or is close to a
6 direction of the selected reception beam is selected.

3. A multi-beam antenna transmitter/receiver
2 according to claim 1, characterized in that reception
3 power or an SIR (Signal to Interference Ratio) is used
4 as an index of the reception quality.

4. A multi-beam antenna transmitter/receiver
2 according to claim 1, characterized by comprising:
3 a reception array antenna in which a reception
4 antenna element is arranged;
5 radio reception means for receiving an output
6 from the reception antenna element, performing a
7 reception process for an input signal, and outputting
8 the signal;
9 reception beam formation means for receiving

10 an output from said radio reception means and forming a
11 reception beam;

12 user demodulation means for receiving an
13 output from said reception beam formation means,
14 calculating an overall reception quality for a path
15 delay/reception beam number of a user signal present in
16 the reception beam to output a user transmission beam
17 number, and outputting user reception data using the
18 path delay/reception beam number;

19 user modulation means for receiving user
20 transmission data, performing a modulation process, and
21 outputting a modulated user signal;

22 user transmission beam switching means for
23 receiving the user transmission beam number and the
24 modulated user signal, and outputting the modulated user
25 signal so as to form a transmission beam corresponding
26 to the user transmission beam number;

27 transmission beam formation means for
28 receiving an output from said user transmission beam
29 switching means, and forming the transmission beam;

30 radio transmission means for receiving an
31 output from said transmission beam formation means,
32 performing a transmission process for an input signal,
33 and outputting the signal; and

34 a transmission array antenna in which a
35 transmission antenna element for transmitting an output
36 from said radio transmission means is arranged.

5. A multi-beam antenna transmitter/receiver
2 according to claim 4, characterized in that said user
3 demodulation means comprises
4 reception beam path detection means for
5 detecting a path delay for each user from an output from
6 said reception beam formation means, and outputting the
7 path delay/reception beam number,
8 path delay/reception beam selection means for
9 selecting the path delay/reception beam number used for
10 demodulation on the basis of a reception quality of a
11 user signal corresponding to the path delay/reception
12 beam number as an output from said reception beam path
13 detection means,
14 demodulation means for performing demodulation
15 using the path delay/reception beam number notified by
16 said path delay/reception beam selection means,
17 reception beam calculation means for
18 calculating an overall reception quality of a user
19 signal for each reception beam from the reception
20 quality of the user signal corresponding to the path
21 delay/reception beam number as an output from said
22 reception beam path detection means, and
23 transmission beam selection means for
24 selecting the transmission beam on the basis of the
25 overall reception quality of the user signal for each
26 reception beam that is notified by said reception beam
27 calculation means, and notifying said user transmission

28 beam switching means of the transmission beam.

6. A multi-beam antenna transmitter/receiver
2 according to claim 5, characterized in that said
3 reception beam calculation means uses reception power as
4 an index of the reception quality and calculates overall
5 reception power as the overall reception quality when
6 the overall reception quality of the user signal for
7 each reception beam is calculated from the reception
8 quality of the user signal corresponding to the path
9 delay/reception beam number as an output from said
10 reception beam path detection means.

7. A multi-beam antenna transmitter/receiver
2 according to claim 5, characterized in that said
3 reception beam calculation means uses SIR as an index of
4 the reception quality and calculates overall SIR as the
5 overall reception quality when the overall reception
6 quality of the user signal for each reception beam is
7 calculated from the reception quality of the user signal
8 corresponding to the path delay/reception beam number as
9 an output from said reception beam path detection means.

8. A multi-beam antenna transmitter/receiver
2 according to claim 5, characterized in that said
3 reception beam calculation means calculates the overall
4 reception quality of the user signal for each reception
5 beam by using a reception quality corresponding to a
6 path delay/reception beam number selected on the basis
7 of a predetermined criterion when the overall reception

8 quality of the user signal is calculated for each
9 reception beam from the reception quality of the user
10 signal corresponding to the path delay/reception beam
11 number as an output from said reception beam path
12 detection means.

9. A multi-beam antenna transmitter/receiver
2 according to claim 8, characterized in that said
3 reception beam calculation means selects P (P is an
4 integer of not less than 2) upper path delays/reception
5 beam numbers excellent in reception quality as the path
6 delay/reception beam number selected on the basis of the
7 predetermined criterion.

10. A multi-beam antenna transmitter/receiver
2 according to claim 8, characterized in that said
3 reception beam calculation means selects, as the path
4 delay/reception beam number selected on the basis of the
5 predetermined criterion, a maximum of Q (Q is an integer
6 of not less than 2) path delays/reception beam numbers
7 with which the reception quality satisfies a
8 predetermined reception quality criterion.

11. A multi-beam antenna transmitter/receiver
2 according to claim 8, characterized in that said
3 reception beam calculation means uses the path
4 delay/reception beam number selected by said path
5 delay/reception beam selection means as the path
6 delay/reception beam number selected on the basis of the
7 predetermined criterion.

12. A multi-beam antenna transmitter/receiver
2 according to claim 1, characterized by comprising:
3 means for forming the plurality of reception
4 beams;
5 means for forming the plurality of
6 transmission beams;
7 means for calculating the overall reception
8 qualities for the respective reception beams by adding
9 values of the reception qualities for the path delays of
10 the user signals; and
11 means for selecting a reception beam excellent
12 in overall reception quality and selecting a
13 transmission beam having a direction which coincides
14 with or is close to a direction of the selected
15 reception beam.

13. A multi-beam antenna
2 transmitting/receiving method characterized by having a
3 plurality of reception beams and a plurality of
4 transmission beams, and selecting the transmission beam
5 on the basis of overall reception qualities calculated
6 from reception qualities of path delays of user signals
7 present in the plurality of reception beams.

14. A multi-beam antenna
2 transmitting/receiving method according to claim 13,
3 characterized in that the reception beam is selected on
4 the basis of the overall reception quality, and the
5 transmission beam having a direction which coincides

6 with or is close to a direction of the selected
7 reception beam is selected.

15. A multi-beam antenna
2 transmitting/receiving method according to claim 13,
3 characterized in that reception power or an SIR (Signal
4 to Interference Ratio) is used as an index of the
5 reception quality.

16. A multi-beam antenna
2 transmitting/receiving method according to claim 13,
3 characterized by comprising:
4 the radio reception step of receiving an
5 output from a reception antenna element which forms a
6 reception array antenna, performing a reception process
7 for an input signal, and outputting the signal;
8 the reception beam formation step of receiving
9 an output from the radio reception step and forming a
10 reception beam;
11 the user demodulation step of receiving an
12 output from the reception beam formation step,
13 calculating an overall reception quality for a path
14 delay/reception beam number of a user signal present in
15 the reception beam to output a user transmission beam
16 number, and outputting user reception data using the
17 path delay/reception beam number;
18 the user modulation step of receiving user
19 transmission data, performing a modulation process, and
20 outputting a modulated user signal;

21 the user transmission beam switching step of
22 receiving the user transmission beam number and the
23 modulated user signal, and outputting the modulated user
24 signal so as to form a transmission beam corresponding
25 to the user transmission beam number;

26 the transmission beam formation step of
27 receiving an output from the user transmission beam
28 switching step, and forming the transmission beam; and

29 the radio transmission step of receiving an
30 output from the transmission beam formation step,
31 performing a transmission process for an input signal,
32 and outputting the signal to a transmission antenna
33 element which forms a transmission array antenna.

17. A multi-beam antenna

2 transmitting/receiving method according to claim 16,
3 characterized in that the user demodulation step
4 comprises

5 the reception beam path detection step of
6 detecting a path delay for each user from an output from
7 the reception beam formation step, and outputting the
8 path delay/reception beam number,

9 the path delay/reception beam selection step
10 of selecting the path delay/reception beam number used
11 for demodulation on the basis of a reception quality of
12 a user signal corresponding to the path delay/reception
13 beam number as an output from the reception beam path
14 detection step,

15 the demodulation step of performing
16 demodulation using the path delay/reception beam number
17 notified in the path delay/reception beam selection step,
18 the reception beam calculation step of
19 calculating an overall reception quality of a user
20 signal for each reception beam from the reception
21 quality of the user signal corresponding to the path
22 delay/reception beam number as an output from the
23 reception beam path detection step, and
24 the transmission beam selection step of
25 selecting the transmission beam on the basis of the
26 overall reception quality of the user signal for each
27 reception beam that is notified in the reception beam
28 calculation step, and notifying the user transmission
29 beam switching step of the transmission beam.

18. A multi-beam antenna
2 transmitting/receiving method according to claim 17,
3 characterized in that in the reception beam calculation
4 step, reception power is used as an index of the
5 reception quality, and overall reception power is
6 calculated as the overall reception quality when the
7 overall reception quality of the user signal for each
8 reception beam is calculated from the reception quality
9 of the user signal corresponding to the path
10 delay/reception beam number as an output from the
11 reception beam path detection step.

19. A multi-beam antenna

2 transmitting/receiving method according to claim 17,
3 characterized in that in the reception beam calculation
4 step, SIR is used as an index of the reception quality,
5 and overall SIR is calculated as the overall reception
6 quality when the overall reception quality of the user
7 signal for each reception beam is calculated from the
8 reception quality of the user signal corresponding to
9 the path delay/reception beam number as an output from
10 the reception beam path detection step.

20. A multi-beam antenna

2 transmitting/receiving method according to claim 17,
3 characterized in that in the reception beam calculation
4 step, the overall reception quality of the user signal
5 is calculated for each reception beam by using a
6 reception quality corresponding to a path
7 delay/reception beam number selected on the basis of a
8 predetermined criterion when the overall reception
9 quality of the user signal is calculated for each
10 reception beam from the reception quality of the user
11 signal corresponding to the path delay/reception beam
12 number as an output from the reception beam path
13 detection step.

21. A multi-beam antenna

2 transmitting/receiving method according to claim 20,
3 characterized in that in the reception beam calculation
4 step, P (P is an integer of not less than 2) upper path
5 delays/reception beam numbers excellent in reception

6 quality are selected as the path delay/reception beam
7 number selected on the basis of the predetermined
8 criterion.

22. A multi-beam antenna

2 transmitting/receiving method according to claim 20,
3 characterized in that in the reception beam calculation
4 step, a maximum of Q (Q is an integer of not less than
5 2) path delays/reception beam numbers with which the
6 reception quality satisfies a predetermined reception
7 quality criterion are selected as the path
8 delay/reception beam number selected on the basis of the
9 predetermined criterion.

23. A multi-beam antenna

2 transmitting/receiving method according to claim 20,
3 characterized in that in the reception beam calculation
4 step, the path delay/reception beam number selected in
5 the path delay/reception beam selection step is used as
6 the path delay/reception beam number selected on the
7 basis of the predetermined criterion.

24. A multi-beam antenna

2 transmitting/receiving method according to claim 13,
3 characterized by comprising the steps of:
4 calculating the overall reception qualities
5 for the respective reception beams by adding values of
6 the reception qualities for the path delays of the user
7 signals; and
8 selecting a reception beam excellent in

9 overall reception quality and selecting a transmission
10 beam having a direction which coincides with or is close
11 to a direction of the selected reception beam.

25. A transmission beam selection method
2 characterized by selecting a transmission beam on the
3 basis of overall reception qualities calculated from
4 reception qualities of path delays of user signals
5 present in reception beams.

26. A transmission beam selection method
2 according to claim 25, characterized in that the
3 reception beam is selected on the basis of the overall
4 reception quality, and the transmission beam having a
5 direction which coincides with or is close to a
6 direction of the selected reception beam is selected.

27. A base station characterized by comprising
2 a multi-beam antenna transmitter/receiver which has a
3 plurality of reception beams and a plurality of
4 transmission beams, and selects the transmission beam on
5 the basis of overall reception qualities calculated from
6 reception qualities of path delays of user signals
7 present in the plurality of reception beams.

28. A mobile station characterized by
2 comprising a multi-beam antenna transmitter/receiver
3 which has a plurality of reception beams and a plurality
4 of transmission beams, and selects the transmission beam
5 on the basis of overall reception qualities calculated
6 from reception qualities of path delays of user signals

7 present in the plurality of reception beams.